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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
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NOAA Technical Memorandum NMFS

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U.S. DEPARTMENT OF COMMERCE
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ABSTRACT

Between 24 July and 6 August 1983, a two-person National Marine Fisheries Service field camp examined the Hawaiian monk seal, Monachus schauinslandi, and green turtle, Chelonia mydas, populations of Necker Island. Forty-three seals were identified, photographic records for seal identification were made, and 21 animals were bleach marked. Of three pups at Necker, only one weaned during the study period and was tagged. A pregnant female was found dead and a necropsy was performed.

Eighty-eight turtle observations included feeding (59), basking (18), and swimming (11) sightings. Four turtles were individually identified; three of these were flipper-tagged.

INTRODUCTION

Although ongoing research at some locations within the Northwestern Hawaiian Islands (NWHI) is providing a sound data base for management decisions concerning the endangered Hawaiian monk seal, Monachus schauinslandi, and threatened green turtle, Chelonia mydas, there is a paucity of information concerning both species at Necker Island. Clapp and Kridler (1977) provide a natural history summary for Necker Island, and Balazs[1] examines some ecological aspects of green turtles on Necker Island.

Information is limited for Necker Island seals and green turtles due to accessibility in part. This precipitious rocky island of 16.6 ha (41 acres) affords safe landings only by small boat and under limited conditions. Furthermore, few usable camp sites exist because of archaeologically sensitive areas and the dramatic topography, which creates logistical problems for field camps.

Necker Island provides one of the few places within the NWHI where significant numbers of monk seals aggregate and reproduce on a rocky substrate. A limited, but consistent, pup production over the last few years suggests that the Necker population is not merely a transient aggregation that utilizes the adjacent waters as feeding grounds.

National Marine Fisheries Service (NMFS) personnel were present on Necker Island on two occasions in 1983. A brief stop on the afternoon of 20 April 1983 allowed time to conduct a partial island seal census. Thirty seals and one dead pup with black pelage were counted.[2] A necropsy was not conducted on the pup due to its close proximity to other seals. From 24 July through 6 August 1983, a two-person NMFS field camp was established at Necker Island to study the monk seal and green turtle populations. This report describes the findings of this latter study.

METHODS AND MATERIALS

Census data were collected every other day, whereas animal marking, photographic identification, and tagging were conducted on noncensus days. Seals and turtles were censused with respect to specific geographic areas of the island (Fig. 1). Sightings in the adjacent waters surrounding Necker Island were also recorded.

Seals

A 3- to 4-h seal census was conducted every other day near midday when a maximum number of individuals were hauled out. The island was divided into two segments, Sectors 01 through 05 and Sectors 06 through 10, and

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[1]Balazs, G. H. 1977. Ecological aspects of green turtles at Necker Island. Unpubl. Rep., 27 p. Hawaii Inst. Mar. Biol., Univ. Hawaii, Kaneohe, HI 96744.

[2]Peiterson, G. A., Southwest Fisheries Center Honolulu Laboratory, National Marine Fisheries Service, NOAA, Honolulu, HI 96812, pers. commun. 1984.

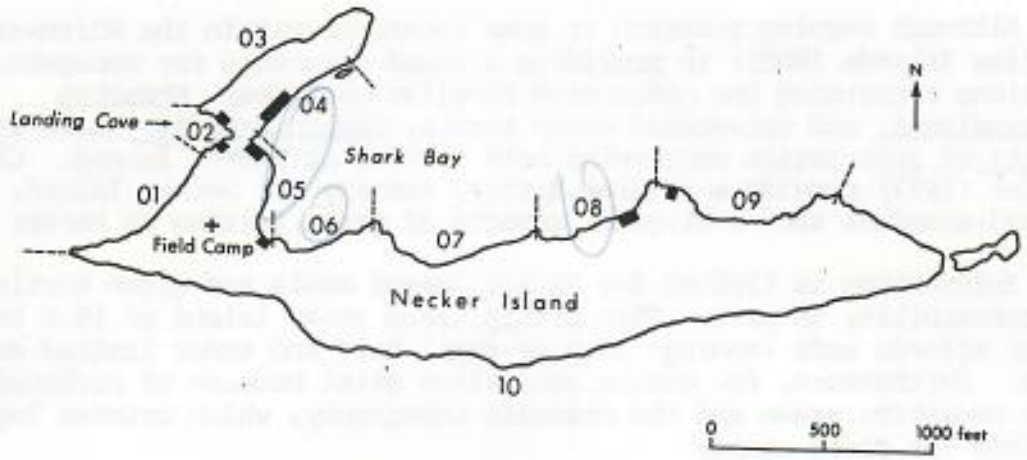

Figure 1.--Census sectors and seal haul-out areas on Necker Island.

each researcher sampled half each census. Sector assignments were exchanged every census. Data were recorded on forms and for each seal included sector, size class (see Stone 1984), sex, beach position, percent molt, and association with other seals or with objects capable of entanglement.

Individual seals were identified by scars and natural markings, or by applied bleach marks (Stone 1984). Identification characteristics were photographed and an identification file of drawings and photographs was compiled. A weaned pup was tagged on both hind flippers with red plastic cattle ear tags (Temple tag[3]); length and girth measurements were taken at time of tagging. Skulls from dead seals were collected, and a necropsy was performed in the event of recent death. Tissues were preserved in 10% Formalin. Scats were collected whenever possible.

Turtles

Turtle research included censusing, observing feeding animals within Shark Bay, tagging, marking, and measuring animals. Censusing turtles was conducted during seal censuses, whereas feeding observations were done opportunistically. Heavy surf conditions prevented the netting and subsequent measuring and tagging of juvenile animals from the rocky beach of Sectors 04 and 05 as reported by Balazs (footnote 1).

Individual turtles were marked temporarily on the carapace with acrylic paint, or permanently on the foreflipper(s) with size 681 Inconel 625 alloy tags.

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[3]Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

RESULTS AND DISCUSSION

Seals

A total of 43 seals were identified: 19 male and 11 female adults; 3 male, 3 female, and 1 unknown subadults; 2 male and 1 female juveniles, 1 female and 1 unknown nursing pups; and 1 male weaned pup (Table 1).

Table 1.--Number of identified seals within size classes by sex, Necker Island, 1983. Animals are listed by identification number with bleach numbers underlined. (M=male, F=female, ?=sex unknown.)

Adult		Subadult			Juvenile		Weaned pup		Nursing pup		
M	F	M	F	?	M	F	M	F	M	F	?
201	[1]200	204	202	238	219	234	228			02P	01P
203	215	212	220		223						
205	[1]217	231	05F								
206	[1]218										
207/225	229										
209	230										
210	236										
211	[2]01F										
213	[3]02F										
216	03F										
224	06F										
226											
227											
233											
237											
250											
251											
252											
253											
Total:											
19	11	3	3	1	2	1	1			1	1

[1]Molting animals.
[2]Adult female with pup (01P) of unknown sex.
[3]Adult female with female pup (02P).

Census Summary

Census data were collected on 6 separate days. A high of 32 animals was recorded on 1 August. A low of 24 animals was recorded on 28 July and 5 August. The mean number of seals censused for Necker Island was 28 (Table 2).

Table 2.--Summary of seal censuses, Necker Island, 1983. (M=male, F=female, ?=sex unknown).

Date 1983	Adult			Subadult			Juvenile			Weaned pup			Nursing pup			Non-pup total	Pup total	Grand total
	M	F	?	M	F	?	M	F	?	M	F	?	M	F	?			
4/20	5	0	13	0	0	7	0	0	4	0	0	0	0	0	0	29	0	[1]30
7/28	8	9	1	0	0	1	2	0	1	1	0	0	0	0	1	22	2	24
7/30	13	6	3	1	2	1	0	0	1	0	0	0	0	0	2	27	2	29
8/01	13	8	3	0	0	1	4	0	0	1	0	0	0	0	2	29	3	32
8/03	12	7	0	2	1	0	2	1	0	1	0	0	0	1	1	25	3	28
8/05	7	5	3	3	1	1	1	0	0	1	0	0	0	0	2	21	3	24

[1]Total includes a seal which could not be placed in any age-sex class.

Preferred haul-out locations were Sectors 02, 04, 05, and 08. Sectors 04, 05, and 08 are large, rocky benches which afford protected locations surrounding Shark Bay. Sector 02, a bench area within the landing cove also affords limited protection from wave action. At the border of Sectors 05 and 06, there is a small cave with a cobbled substrate that accommodates animals during lower tides. No animals were seen hauled out in Sectors 01, 03, or 10, but it was impossible to view portions of these sectors from land; haul out in these sectors is unlikely as they are mainly vertical cliff face. Sectors 02 and 08 were utilized predominantly by adult males. Sightings of known animals in different sectors throughout the study suggest that some seals show little site specificity.

Tidal changes had minimal effect on haul-out patterns. Wave conditions did, however, influence accessibility to haul-out areas. A strong northeast swell eliminates Sectors 08 and 06 as usable haul-out sites. South swells would influence Sectors 04 and 05 similarly.

A total of three pups were present--two nursing and one weaned. Two mother and pup pairs were present in Sector 05. One nursing pup was female; the other's sex was undetermined. Approximate dates of birth were estimated to be 4 July for the unsexed larger pup and 9 July for the female pup. Both pups appeared healthy and were nursing regularly. The weaned pup, a male, was seen in Sector 08, and was tagged A01 and A02. The pup appeared healthy and based on a slight eruption of the teeth, had been weaned less than 10 days. A recent survey of Necker Island in June 1982 reported three nursing pups in Sector 05 and one nursing pup in Sector 08 (Conant 1985).

Monk seals often exhibit evidence of major injuries resulting from shark attacks and adult male seal aggression. Of the 15 known females, 4 adult animals were seen with old scars or healing dorsal wounds which were characteristic of those caused by adult male aggression. Two subadult females also had major dorsal wounds (Table 3). No male-female aggression was seen which resulted in fresh wounds. Limited haul-out area often

Table 3.--Monk seals with dorsal scars and recent dorsal wounds. (M=male, F=female, ?=sex unknown, A=adult, S=subadult).

Temporary bleach No.	Permanent identification No.	Age-sex	Fresh wounds	Scars
	02F	AF		x
	03F	AF	x	
	05F	SF	x	x
	06F	AF	x	
229		AF		x
238		S?		x

forced animals into sex- and size-class associations of closer proximity than commonly seen on other NWHI beaches.

On 28 July 1983, an unidentified pregnant female was found dead in Sector 08. The animal had been dead no longer than 40 h and had a few shallow dorsal wounds. A necropsy was performed on 29 July (Appendix A). The cause of death was not apparent, although it may have been related to pregnancy or the back injury. The skull of the pregnant female and unborn pup were collected, as was the skull from the pup initially observed dead on 20 April.

Four scat samples were collected for examination at the laboratory.

Turtles

Four turtles were individually identified. Three of these were tagged during the study and one was temporarily identified with carapace paint (Table 4). No tags from earlier studies at Necker Island or elsewhere in the Hawaiian Archipelago were seen.

Table 4.--Green turtles tagged, marked, and resighted, Necker Island, 1983. (M=male, F=female, A=adult, Im=immature).

Tag						Straight carapace measurements (cm)	
Right	Left	Sex	Age class	Date tagged 1983	Sector	Length	Width
7428	7427	M	Im	07/26	04	76.5	60.5
7430	7429	F	Im	08/01	05	77.7	60.5
(Painted)		F	A	08/02	05	83.1	
7431	7432	M	A	08/05	05		

A total of 88 turtle sightings were recorded for the 14-day period (Table 5). All of the sightings were concentrated in the western portion of Shark Bay or within the landing cove (Fig. 2). Of the 88 sightings, 59 (67.0%) were animals actively feeding. Nearshore areas of Sectors 04, 05, and 06 are important feeding areas containing five principal kinds of benthic algae including Caulerpa, Sargassum, Laurencia, Turbinaria, and Asparagopsis (see footnote 1). Due to the proximity of monk seals, no attempt was made to sample algae from the mouths of turtles.

Table 5.--Turtle sightings, Necker Island, 24 July-6 August 1983 (n = 88).

Date 1983	Sector	Time	Age and sex (if determined)	Activity	Comments
7/24	05	1000	Adult	Basking	
			Adult	Basking	
			?	Basking	
7/26	04	0930	Immature	Basking	
			Immature	Basking	Tag No. 7427, 7428
7/28	06	1314	Adult	Feeding	
			Adult	Feeding	
			Adult	Feeding	
			Adult	Feeding	
	05	1330	Adult female	Basking	
	06	1530	Adult	Feeding	
			Adult	Feeding	
			Adult	Feeding	
			Adult	Feeding	
			Adult	Feeding	
			Adult	Feeding	
7/29	06	1600	Immature	Feeding	
			Immature	Feeding	
	06		Adult	Feeding	
	06		Adult	Feeding	
	06		Adult	Feeding	
7/30	06	1330	Adult	Feeding	
			Adult	Feeding	
			Immature	Feeding	
	05	1430	Adult	Swimming	
	02	1630	Adult	Swimming	
			Adult	Swimming	
	06	1700	Adult female	Feeding	
			Adult	Feeding	
			Adult female	Feeding	
			Immature	Feeding	
Center of Shark Bay			Adult	Swimming	

Table 5.--Continued.

Date 1983	Sector	Time	Age and sex (if determined)	Activity	Comments
7/31	02	1530	Immature	Swimming	
	05	1530	Adult	Basking	
			Adult	Basking	
8/1	02	1800	Adult	Swimming	
	04	1800	Immature	Feeding	
	06	1330	Adult	Feeding	
			Adult	Feeding	
			Adult	Feeding	
		1700	Adult	Feeding	
			Adult	Feeding	
			Adult	Feeding	
			Adult	Feeding	
			Adult	Feeding	
			Adult	Feeding	
			Adult	Feeding	
			Adult	Feeding	
	05		Immature	Basking	Tag No. 7429, 7430
8/2	02	0930	Adult	Swimming	
	05	1130	Adult female	Basking	Painted animal
	05	1200	Immature	Basking	Tag No. 7429
	06	1400	Adult	Feeding	
			Adult	Feeding	
			Adult	Feeding	
		1700	Adult	Feeding	
			Adult	Feeding	
			Immature	Feeding	
	06, Center of Shark Bay		Adult	Feeding	
			Adult	Feeding	
	Center of Shark Bay	1700	Adult	Swimming	
			Adult	Swimming	
	05	1730	Adult female	Basking	Painted animal
8/3	02	0645	Adult	Swimming	
	05		Adult	Basking	Entered water
	02	1330	Immature	Swimming	
	06		Adult	Feeding	
			Adult	Feeding	
	06, Center of Shark Bay	1730	Adult	Swimming	
8/4	06, Center of Shark Bay	1230	Adult	Swimming	

Table 5.--Continued.

Date 1983	Sector	Time	Age and sex (if determined)	Activity	Comments
8/4			Adult	Swimming	
			Adult	Swimming	
	05	1915	Adult female	Feeding	Painted animal
			Adult	Feeding	Fed 45 min
8/5	05	1500	Adult female	Basking	Painted animal
			Adult male	Basking	Tag No. 7431, 7432
	04		Adult	Feeding	
			Adult	Feeding	
	06, Center of Shark Bay	1700	Adult	Swimming	
	06	1700	Adult female	Feeding	
			Adult male	Feeding	
	05	2200	Adult female	Basking	
			Adult male	Basking	
8/6	05	0930	Immature	Feeding	
			Immature	Feeding	
			Adult female	Feeding	
			Adult	Feeding	
			Adult female	Basking	Painted animal

Forty-three of the 59 feeding sightings (72.8%) were recorded in Sector 06. This area consisted of an algae-rich nearshore bench which was heavily grazed under calm to moderate surf conditions. Deeper shelves provided grazing sites during larger surf, and feeding animals were observed there throughout the day.

Only 15% of the feeding animals observed were immature (<80 cm straight carapace length). As has been suggested by Balazs (1976), dispersal of hatchlings from French Frigate Shoals results in aggregations of immature turtles at coastal feeding pastures throughout the archipelago. The nearshore area around Necker Island is a foraging habitat utilized primarily by adults.

Although all of the feeding sightings range from 0930 to 1915, these data reflect several biases. Primarily, a majority of the turtle sightings coincided with seal observations, which were carried out in the afternoons. Secondly, feeding activity was difficult to observe from the observation points on Necker Island if the sun was at an acute angle. Finally, during the 2-week period, heavy surf conditions persisted which prevented most feeding activity in the easily observable shallow nearshore waters of Sectors 04 and 05. Balazs (footnote 1) reported that feeding within these areas occurred primarily at sunrise and sunset in conjunction with lower tides, and 1983 observations were not made between 0000 and 0530.

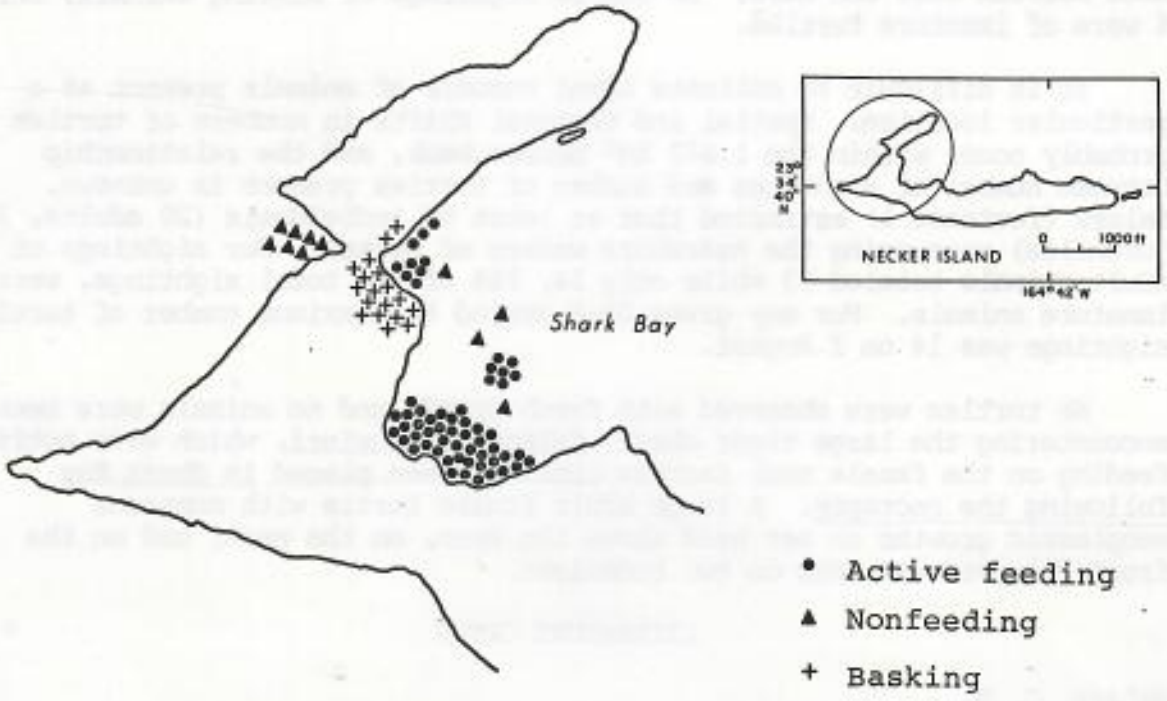

Figure 2.--Distribution of turtle sightings on Necker Island, 24 July-6 August 1983; total sightings = 88.

The rocky ledge of Sector 05 was the only location on Necker Island where adult turtles basked. Although Sector 08 affords apparently suitable substrate for such behavior, at no time during this study was basking observed there. Two immature animals were seen on 26 July partially hauled out on large boulders within Sector 04. Similar basking by immature turtles, although rare, has been observed at areas of Pearl and Hermes Reef as well (Morrow[4]).

The greatest number of animals observed using the rocky ledge of Sector 05 at any given time was three on 24 July. Both Balazs (footnote 1) and Clapp and Kridler (1977) report maximum basking numbers of five. Seals also utilize the bench area, primarily as access to the interior rocky hauling and pupping area of Sector 05. On numerous occasions, seal interactions, primarily between adult males took place on the bench or in adjacent waters. Basking turtles were repeatedly disturbed by these interactions and would return to the water.

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[4]Morrow, R. J. 1984. Results of 1983 turtle research at Pearl and Hermes Reef. Manuscr. in prep. Southwest Fish. Cent. Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96812.

Basking sightings ranged from 0645 to 2200. All but two of the basking sightings occurred during daylight hours. Observations were not made between 0000 and 0530. Of the 18 sightings of basking animals, only 4 were of immature turtles.

It is difficult to estimate total numbers of animals present at a particular location. Spatial and temporal shifts in numbers of turtles probably occur within the 1,683 km^2 Necker bank, and the relationship between number of sightings and number of turtles present is unknown. Balazs (footnote 1) estimated that at least 50 individuals (20 adults, 30 juveniles) were using the nearshore waters of Necker. Our sightings of adult animals totaled 73 while only 14, 16% of the total sightings, were immature animals. For any given 24-h period the maximum number of turtle sightings was 14 on 2 August.

No turtles were observed with fresh wounds and no animals were seen encountering the large tiger shark, Galeocerdo cuvieri, which were actively feeding on the female seal carcass that had been placed in Shark Bay following the necropsy. A large adult female turtle with numerous neoplastic growths on her head above the eyes, on the neck, and on the front flippers was seen on two occasions.

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APPENDIX A

01 Necropsy: Necker Island, 1983
I.D. Unmarked/untagged
Date of data: 29 July 1983
1200-1500
Location: Necker Island,
Sector 08

Monachus schauinslandi
Sex: Female
Size class: Adult

Circumstances.--Lone adult female found floating on her back in a tidal pool midbench, 28 July 1983 approximately 1430. Pelage was slipping and abdominal swelling was quite pronounced, a result of tissue deterioration and accumulation of gases within the body cavity. Animal last seen alive 26 July 1983, 1530, in the same pool accompanied by an unidentified adult seal.

Reproduction data.--Pregnant.

Summary of findings.--Three dorsal wounds, shallow, into blubber only. No other external wounds. Esophagus and trachea contained blood. No blood in heart. Heart had moderate fat content (internal and external). No obvious hemorrhaging in body cavity. All internal organs appeared intact (but decomposing rapidly). Stomach and small intestine were empty; light parasite load. Large intestine fecal sample saved for analysis. Ovaries not found.

Fetus: Skull disarticulated. Internal organs all present and intact. No obvious abdominal hemorrhage. Blood in mouth, trachea, and lungs (frothy). Placenta ruptured. Fetus partially in vagina.

Specimens collected.--Stomach parasites
Large intestine (rectum) fecal sample
Skull--Adult female and fetus

Note: Internal organ tissues too decomposed for analysis. Tissues sectioned for parasites--none found.

Fetus:
- Standard length: 89.5 cm
- Axillary girth: 61.0 cm
- Flipper length (anterior edge):
  - Left foreflipper: 14.0 cm
  - Left hind flipper: 20.5 cm
- Weight: 9 kg (estimated)
- Sex: female

Adult female:
- Standard length: 2.15 m
- Axillary girth: Not determined
- Flipper length (anterior edge):
  - Left foreflipper: 39.0 cm
  - Left hind flipper: 36.0 cm
- Blubber thickness (sternum): 3.5 cm

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